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AUTOMATED DIAGNOSTICS OF DAMAGE OF ALUMINUM ALLOY UNDER CONDITIONS OF HIGH-CYCLE FATIGUE

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The analysis of loading conditions of modern civil aircrafts, the existing methods for evaluation of the accumulated fatigue damage, peculiarities of fatigue damage of aviation structural materials, results of previous fatigue investigations allowed formulating the approach to solving the problem of the quantitative evaluation of the accumulated fatigue damage of the aircraft structural elements. Cyclic loading forms the deformation relief on the surface of structural aluminum alloys, the intensity of which indicates the level of the accumulated fatigue damage. The relief of this type was observed both on standard specimens for fatigue tests in a broad range of loading conditions and on specimens prepared from the skin of the An-24 aircraft and tested under stresses close to the operational ones. The results of the investigations carried out using the methods of optical and electronic microscopy show the appropriateness of using the "deformation relief" term and applying it as a diagnostic parameter of fatigue damage. It is shown that cyclic loading on the surface of structural aluminum alloys causes the nucleation and development of the deformation relief, the intensity of which indicated the level of the accumulated fatigue damage. The quantitative parameter of damage in case of fatigue of the aluminum alloys is established, which is the saturation of surface with visual signs of the deformation relief. This parameter can be determined by the optical microscopy methods. The instrumental base and software were developed for the automated calculation of the damage parameter. The identification and quantitative analysis of the deformation relief of the aluminum alloy for the aircraft construction based on the processed digital images is performed. The behaviour of defects is assessed by the results of diagnostics of individual stages of the deformation process. It is established that the individual stages of the damage accumulation process are characterised by their own values of the integral image parameters. Based on the consecutive processing of the data on the surface cyclic deformation the main regularities in the propagation of defects are found. The theoretical preconditions are substantiated and the experimental results are obtained.